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The present study examined individual differences exhibited by reflective and impulsive school-age children, at each of two grade levels, with regard to their efficiency in constructing organizational schemes during a pre-recall sorting period, and their spontaneous tendencies to carry over these schemes into free recall.

Ninety-three children of average intellectual ability from grades one and four were administered the Matching Familiar Figures Test in order to identify 12 reflective children and 12 impulsive children at each of grade levels one and four. These 48 children were administered the experimental sorting and recall task.

The pre-recall sorting task consisted of grouping pictures the subject deemed went together the best. Sorting trials continued until the subject reached a stable sorting scheme on two successive trials, or until he had completed six trials. At the end of the last sorting trial, a distractor task was administered, after which the subject was asked to freely recall the items. Following the free recall task, categories were reconstructed to obtain the subjects' sorting rationale.

Results indicated that older children form larger sorting categories, require fewer trials to establish a stable set of categories during a free sorting period and

show higher levels of organization and recall than younger children. Additional findings supported the hypotheses that impulsive children take less time to arrive at sorting schemes in any given sorting trial, require more trials to reach a stable sorting criterion, and show poorer levels of organization and recall than reflective children. Using a modification of Robinson's Item Clustering Index to assess organization, it was found that clustering was significantly related to recall performance for children at each age level.

Performance differences between impulsive and reflective children were not apparent when recall-clustering measures were adjusted for subjects' differential performance in the pre-recall sorting task, i.e., sorting time per trial and number of trials to sorting criterion. It was concluded that the performance deficits found among impulsive children at each age level were attributable to low levels of attention focused upon potentially meaningful relationships between stimulus items.

# SORTING-RECALL BEHAVIORS EXHIBITED BY REFLECTIVE AND IMPULSIVE CHILDREN: AN INDIVIDUAL DIFFERENCES INVESTIGATION OF DEVELOPMENTAL MEMORY

by

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# CHAPTER I

# INTRODUCTION

## Background for Study

In recent years a substantial amount of research in the area of children's cognitive processes has been concerned with the memorizing capabilities of children of various ages in a variety of tasks and situations (Appel, Cooper, McCarrell, Sims-Knight, Yussen, & Flavell, 1972; Cole, Frankel, & Sharp, 1971; Flavell, Beach, & Chinsky, 1966; Moely, Olson, Hawles, & Flavell, 1969; Neimark, Slotnick, & Ulrich, 1971; Scribner & Cole, 1972). Without exception these investigations have indicated that children's performance in memory tasks improves dramatically during the primary school grades. However, the processes responsible for these developmental gains have not been clarified. One possible explanation is that older children tend to organize incoming information prior to recall, and this self-imposed organization enhances the amount of an individual's recall. Mandler (1967), in his research with adult subjects, has shown that the number of items an individual can freely recall is a direct function of the degree to which the subject has the opportunity to group or categorize items-to-be-remembered prior to the recall

period. Hence, it might be assumed that developmental trends in recall abilities reflect greater spontaneous tendencies on the part of the older child to organize information presented to him.

In an attempt to test the organizational deficiency hypothesis pertinent to the recall of younger school age children, several developmental investigators have observed the order in which children freely recall information presented to them. Typically, the child is shown pictures (or words representing two or more mutually exclusive taxonomic categories (e.g., vehicles, furniture, food, etc.). These items are presented in a random order in such a way that no two instances of a single category appear next to one another in an array, or adjacent to one another if the items are presented one at a time. After the items are removed from view the child is asked to recall as many of the items as he can in any self-chosen order. By assuming that children prefer to organize according to the taxonomic properties of the presented items, one can derive an index of organization which refers to the degree to which same-category items are verbalized adjacently to one another in the recall sequence. Such an index is generally referred to as a measure of clustering, that is, a measure of the degree to which items belonging to the same taxonomic or conceptual categories are found to be clustered together by the subject during his recall. It is a general finding that recall

clustering scores increase with age during the early school age years in much the same function that appears for the "number of items recalled" measure (Cole et al., 1973; Horowitz, 1969; Lange, 1973; Liberty & Ornstein, 1973; Moely et al., 1969, Neimark et al., 1971). Further, positive relationships between clustering and amount recalled appear only for older children (Furth & Milgram, 1973; Horowitz, 1969; Moely et al., 1969).

Based upon these findings some investigators have concluded that superior recall on the part of older children (i.e., those eight years of age and older) is a direct function of their spontaneous attempts to organize their material prior to recall. Younger children, on the other hand, are assumed to be deficient in organization--a tendency which is thought to account for their poor retention.

The difficulty with the clustering measures used in such studies has been discussed by Lange (1974) and Lange and Jackson (1974). The major weakness of the clustering index for use with children is that of assessing preferred organizational schemes of children in reference to adult-defined taxonomic criteria. Several studies have shown that younger children sort into smaller, more fragmented categories, often employing different sorting criteria than older children and adults (Annett, 1959; Goldman & Levine, 1963; Lange & Hultsch, 1970; Liberty & Ornstein, 1973; Saltz & Siegel, 1967; Saltz, Soller, & Siegel, 1972). Thus, it

seems that younger children would make poorer approximations to category schemes defined by an adult experimenter than would older children, and therefore, would receive lower clustering scores which would underestimate their true organizational abilities (Lange, 1974).

In an attempt to overcome this limitation, Lange and Jackson (1974) measured clustering in reference to children's personally-defined categories in order to gain a more accurate estimate of children's true organizational capabilities. In contrast to previous research these investigators found relatively high levels of clustering among children as young as six years of age, as well as strong positive relationships between clustering and recall among all age groups of school children. Hence, it appears that school children of all ages show spontaneous tendencies to organize their recall according to personally-defined criteria, and are capable of facilitating their retention accordingly.

Notwithstanding investigators' recent concern with the "personal" organizing tendencies of young learners, little, if any attention has been given to individual differences in the qualitative aspects of children's organizational schemes at differing age levels and how this affects the extent to which children can remember presented information. The purpose of the present study was to examine conceptual tempo as an individual difference dimension which

seemed to be related to the proficiency of children's organizational behavior in retention tasks, and to the relationship between organization and recall. Conceptual tempo, as operationally defined by Kagan and his colleagues, has involved two dimensions, time and errors, in an attempt to assess the response latency and accuracy of the individual placed in various situations of response uncertainty. Reflective children have been described as slow and accurate, while impulsives have been described as fast and inaccurate in such task settings. The study examined individual differences exhibited by reflective and impulsive children, at each of two age levels with regard to their efficiency in constructing organizational schemes during a pre-recall sorting period, and with regard to their spontaneous tendencies to carry over these schemes into free recall. Previous research focusing on the conceptual tempo dimension has indicated that impulsive children tend to make more commission errors on serial-recall tasks, to make more errors while reading, to respond more quickly on inductive reasoning tasks, and generally to show shorter response latencies in other task settings which involve response uncertainty (Kagan, 1965c; Kagan, 1966b; Kagan, Pearson & Welch, 1966a; Kagan, Rosman, Day & Albert, 1964). These findings were presumed to reflect the impulsive child's consistent failure to consider and evaluate available alternatives or

strategies when performing in cognitive task settings having moderate to high levels of response uncertainty.

Previous research has not clearly indicated how conceptual tempo may contribute to strategy differences exhibited by reflective and impulsive children, and specifically to the differences in their problem-solving performance. Adams (1972) analyzed task strategies in a probability learning task and found that there was a difference between reflective and impulsive children at the six-year-old age level; however, this finding was not apparent in the eight-year-old sample. McKinney (1973) administering a series of problem solving task to second grade children found that reflective children employed more efficient hypothesis-testing strategies than did impulsive children.

## Statement of the Problem

In the present study it was reasoned that since impulsive children are more likely to process information in a more random, trial-and-error manner (McKinney, 1973), they would display less concentrated attention, fail to be planful in identifying meaningful associations between stimulus items and, in general, have greater difficulty than their reflective counterparts in forming stable organizational sorts (i.e., arriving at the same sorting categories on two successive sorting trials). Since these cognitive behaviors seem necessary for the effective use of mature strategies in

task situations, and in view of the impulsive child's failure to use such strategies, it was reasoned that the impulsive child would be less likely to refer to his sorting schemes as a means to enhance his recall during the task's recall phase. Thus, the impulsive child was expected to show inefficient performance when attempting to classify presented information, low levels of organization during his free recall and correspondingly, poor levels of retention during free recall.

## Significance of the Problem

The great majority of developmental research in children's memory has ignored the degree to which same-age children differ in their approaches and successes in memory-task settings. The present investigation focused on one individual difference variable, reflectivity-impulsivity, believed by this writer to be of critical importance for effective memorizing performance. That is, if a child is to benefit from the use of a mature memorizing strategy, in this case one that enables him to organize his to-be-remembered materials before recall, he must possess the ability to (a) carefully attend to the meaningful properties of presented information, (b) make discriminations between the presented items, (c) arrive at common dimensions along which several items can be related or organized, and (d) possess a conscious will to refer to his organizations

during a retention period. The present investigation was conducted to point out that impulsive children, during the elementary school age years would be deficient in performing these functions, and consequently, would show poor recall and organization performance when attempting to remember presented items during a free recall period.

## Hypotheses

In accord with the previously stated rationale, the following hypotheses were tested:

(1) Older children form larger sorting categories than younger children.

(2) Older children require fewer trials to establish a stable set of categories during a free sorting period than younger children.

(3) Older children show higher levels of organization in their recall, and hence, higher levels of recall than younger children.

(4) Impulsive children at each grade level take less time to arrive at a sorting scheme in any given sorting trial than reflective children.

(5) Impulsive children at each grade level require more sorting trials to establish stable sorting schemes than reflective children.

(6) Impulsive children at each grade level show poorer levels of recall clustering, as well as amount recalled,

than reflective children due to the poorer carry-over of organization into the recall task.

## Definition of Important Terms

The following definitions of key terms were provided for clarity.

Free recall method. Items are shown either in succession or an array to the subject during a presentation period. The subject is then asked to freely recall the presented items in any order that he chooses. Recall is measured in terms of the total number of items the child can verbally recall (Tulving, 1968).

Organization. One or more classificatory units imposed upon an array of presented information. Organization in recall can be inferred by the degree to which items representing the same classificatory unit are verbally recalled adjacent to one another.

Recall clustering. The degree to which items from the same classificatory unit are recalled in an adjacent order during verbal recall.

Taxonomic recall clustering. An index which assesses the degree that items belonging to the same experimenter-defined category are recalled in an adjacent order during verbal free recall.

Personal recall clustering. An index which assesses the degree that items belonging to the same self-defined

classifocatory categories are recalled in an adjacent order during verbal free recall.

Stable sorting. Stimulus items are grouped together in an identical manner on two successive sorting trials.

Conceptual tempo. The degree to which a person considers alternatives in problem-solving situations containing response uncertainty. It is operationally defined by the response latency of the individual and the number of errors committed during the task. Individuals are described as being reflective or impulsive.

Relectivity. A reflective child is one who is above the median on response time and below the median on errors committed. He is considered to be slow and accurate.

Impulsivity. An impulsive child is one who is below the median on response time and above the median on the number of errors committed. He is considered to be fast and inaccurate.

# CHAPTER II

## RELATED LITERATURE

The intent of this chapter was to review research and theoretical literature related to (a) the degree to which school children of different ages employ organizational strategies to guide their recall in memory task settings, and (b) the manner in which reflective and impulsive children function in tasks permitting the use of cognitive skills. The purpose of this literature review was to provide support for the present thesis that reflective and impulsive children will show differing levels of success in memory task settings which permit the subject's use of organizational strategies to enhance retention. Although the present research focused on individual differences in children's memory performance, there was little research to discuss in this regard.

### Children's Spontaneous Tendencies to Organize Their Recall

Much of the previous developmental research on children's organized recall has been designed according to the category clustering paradigm developed by Bousfield (1953). Children have been asked to view taxonomically related words or pictures and then to freely recall the items. The

children's ability to organize their free recall has been assessed in reference to categorical properties of the stimuli as defined by the experimenter. That is, the more the individual has organized his recall according to the taxonomic structure built into the list by the experimenter, the greater is his clustering score.

Children's Organization According to Experimenter-Defined Criteria

Rossi (1964) utilized Bousfield's associative clustering method to investigate the development of classificatory behavior in five, eight, and eleven-year-old children. Two stimulus lists, each composed of twenty items, were presented to different experimental groups for viewing and recall. List one included twenty words from each of four conceptual categories. In list two the names of the conceptual categories were substituted for one word in each respective category. Results indicated a linear relationship between clustering and age.

Vaughan (1968) presented nonclustered and clustered lists composed of pictorial materials to first, fourth and seventh grade children over five trials. Recall was taken after each trial and was found to increase as a function of age and the clustered picture list. All age groups showed a tendency toward clustering. Clustering during recall increased with age with the younger age groups recalling fewer items per conceptual category.

Moely, Olson, Hawles and Flavell (1969) hypothesized that organization among young children resulted from a production deficiency, i.e. failure to utilize mediational strategies. Children from grades K, one, three, and five were assigned to one of three conditions: A control condition in which grouping of the stimuli was permitted but only labeling of each picture was required; a naming condition in which the experimenter labeled each category and pointed out its members; and a teaching condition in which the experimenter required each subject to name each item, sort into experimenter-defined categories, label the categories, and count the number of items in each category. Following a two minute study period, recall was obtained. General increases in category clustering with age were found for both the study period and free recall phases of the task, indicating a greater tendency for older children to spontaneously organize presented materials. No age differences were found for the teaching condition. Kindergarten and first grade children increased their clustering activity only in the teaching condition, whereas the naming condition was sufficient to facilitate clustering in the older children.

Scriber and Cole (1972) trained second, fourth, and sixth graders under two conditions: A constrained recall condition in which the subjects were forced to recall by categories, and a cued recall condition in which the subjects were given the option for using experimenter-defined

categories during recall. The stimulus list was composed of twenty words from four conceptual categories. Results indicated a greater facilitation of recall and clustering among subjects in the constrained condition. However, this superiority in recall performance did not transfer when subjects were later required to recall on a new list containing different categories.

There have been marked discrepancies in the literature pertaining to children's categorical clustering. While several of the above-mentioned investigators have presented evidence indicating that children as young as two-to-five show above chance clustering in their free recall (Moely et al., 1969; Rossi, 1964; Vaughan, 1968), others have found that clustering abilities first become evident in children aged eight-to-ten or older (Furth and Milgram, 1973; Lange, 1973). Lange (1974) has explained these discrepancies in terms of researchers' failures to distinguish between conceptual and associative clustering. He pointed out that "items that belong to the same conceptual categories also have greater inter-item semantic relatedness than items belonging to different categories" (p. 2). This becomes significant when considering the high clustering levels reported by some experimenters to occur among young children. Previously, experimenters have not controlled the associative relatedness of stimulus items; therefore, clustering may simply reflect highly practiced word associations and not

conceptual skills needed for recall organization. The standard clustering index appears to be as sensitive to these associative modes as to the conceptual modes.

To support this position, Lange (1973) assigned children from grade levels K, five, and nine to one of four instructional conditions: Serial recall (SR); standard free recall (FR); labeling free recall (LFR); labeling cued recall (LCR). Items from four conceptual categories were controlled so as not to be considered highly associative. Subjects in the free recall condition from grades K and five "showed no tendency to cluster their verbal recall according to experimenter-defined conceptual criteria and had no greater recall than their peers in the serial condition" (Lange, 1973, p. 403). However, ninth graders scores reflected nearly half of the total clustering possible. Hence, under conditions where associative responses are minimized it appears that younger children do not group items as defined by the experimenter's taxonomic categories.

Studies which have employed labeling techniques provide further evidence that younger children do not focus on experimenter-defined taxonomic or conceptual properties of stimuli when behaving in memory settings. For example, Horowitz (1969) investigated the possible facilitative effects that verbal labeling would have on clustering in five- and eight-year-old children. Twelve words belonging to four conceptual categories were presented via visual,

auditory, or audio-visual modes. Although the labeling effects upon recall depended upon presentation modes, generally verbal labeling facilitated clustering more for the older age group than the younger one. Similar findings have also been reported by Furth and Milgram (1973), Lange (1973) and Moely et al. (1969). If children are not predisposed to organize stimuli according to experimenter-defined conceptual criteria, this may be the reason for their ignoring conceptual cues given during labeling conditions.

Children's Organization According to Subjectively-Defined Criteria

Lange (1974) and Lange and Jackson (1974) have closely examined the findings that younger children have appeared less strategic in studying, storing and retrieving information in free recall tasks and suggested a second weakness of the standard clustering index. Investigators have found that younger children sort into smaller, more fragmented categories, often employing different sorting criteria than older children and adults. Therefore, by assessing the organizational schemes of children based upon the taxonomic criteria, it is possible to underestimate the organizational abilities of younger children.

To remedy the inadequacies of measuring children's organization in reference to adult-defined taxonomic categories, several investigations have been conducted in which

clustering during the free recall task has been examined in reference to personal categories obtained from an initial sorting task. Mandler and Stevens (1967) presented fifteen high frequency words to second, fourth, sixth and eighth grade girls. There were two groups within each grade level: a "free" group who imposed their own categorization on the stimuli and were required to reach a stable sorting criterion, and a "constrained" group who were yoked to subjects in the "free" condition and were required to sort the words into the categories of their yoked counterpart. A free recall period followed the sorting period. Younger children took more time, more trials, and made more errors in categorizing in either condition than did older children. There was an age trend found in children's tendency to cluster material during recall according to the categories established during sorting. However, only for eighth graders was there a significant correlation between the number of categories and the amount of recall.

Lange and Hultsch (1970) examined the relationship between organization and recall in children from grades one, three, five, seven and nine. Children were assigned either to a sorting condition in which the children had to overtly categorize the materials to a criterion of two successive sorting trials, or were assigned to a non-sorting condition in which they were not permitted to categorize the stimuli overtly. It was hypothesized that the sorting condition

would facilitate recall for the first, third, and fifth grade children, but that the seventh and ninth grade subjects would show less facilitation since they would covertly organize the stimuli under the non-sorting condition. Results indicated that the sorting subjects recalled significantly more items than the non-sorting subjects at grade levels one, three, and five, but not at seven and nine.

Denney and Ziobrowski (1972) compared the performance of children and adults on two stimulus lists--one in which the categories were composed of word pairs complementarily related and a second list in which the word pairs were similarly related. Based upon evidence from a variety of areas (e.g., word association studies, conceptual style studies, and free classification studies), they hypothesized that children would cluster more on the complementary word list, whereas adults would cluster more on the similarity word list. Using experimenter-defined categories, clustering and recall were not found to be significantly related; however, there was a significant interaction between age and list on clustering scores. Children did cluster more on the complementary word list and adults on the similarity word list. These findings provided further evidence that children and adults categorize according to different criteria.

Liberty and Ornstein (1973) assigned fourth graders and college students to six experimental conditions. Two conditions, designated as free-sorting conditions, allowed

subjects to employ a self-chosen sorting strategy. Under the four remaining constrained conditions, subjects were forced to learn sorting patterns developed by the other subjects: fourth graders were yoked to fourth graders; fourth graders, to adults; adults, to fourth graders; adults, to adults. Categories were less distinct and content-defined by the fourth graders, and no above chance clustering was observed during free recall for the fourth graders. Under the constrained sorting condition, the sorting patterns of adults were easier for both children and adults to learn and recall was improved for the fourth graders using these strategies. Adults yoked to fourth graders showed impaired recall. Subjects constrained to one of their own age group did not affect recall performance. These findings also provided support for the notion that adults and children organize materials presented to them according to different criteria and that these changes in organization can affect recall performance.

Lange and Jackson (1974) analyzed clustering during free recall in reference to personal sorting categories established by subjects during a free-sorting task. Sixty subjects, twelve from each grade level one, four, seven, and ten and college freshmen, were asked to sort twenty pictures until stable sorting schemes were established; after which a single verbal recall task was given. Reasons for the sorting categories were scored on the basis of descriptive,

functional-contextual and class-inclusion content. The recall data showed that subjects across grade levels referred to their sorting categories established during free recall, and that the relationship between personal clustering and amount of free recall were significant at each grade level. First graders clustered nearly 50 per cent of the potentially clusterable pairs; fourth graders, 60 per cent. These clustering levels were higher than for measures obtained when experimenter-defined categories were used as the referents for assessing clustering in recall. Children within age groups were highly consistent in giving their explanations in a particular context. Older children preferred to organize pictorial stimuli on the basis of mutual class membership, whereas younger children preferred to organize pictures on the basis of functional or contextual relatedness.

## Cognitive Behaviors of Reflective and Impulsive Children

Research initiated by Jerome Kagan and his colleagues (1964) investigated a specific area of cognitive style called reflection-impulsivity. The reflection-impulsivity dimension is concerned with the degree to which a person considers alternatives in problem-solving tasks containing response uncertainty. Reflectivity is operationally defined as being both slow and accurate; those persons above the median on response time and below the median on the number of

errors committed are considered reflective. The converse of this behavioral disposition is defined as impulsivity; those persons are quick and make many errors (Kagan, 1965a, 1965b, 1965c, 1966a). There are several tests used as indices of reflection-impulsivity; however, the Matching Familiar Figures test (MFF) is most often utilized. In this task the child is shown a standard picture and six comparison pictures, only one of which is identical to the standard. The subject then attempts to select the variant that is identical to the standard. Subjects are scored on the number of errors they make, and the response time to the first selection. Research pertinent to the reflection-impulsivity dimension, based on the MFF, can be classified into five major categories: studies of the generality of response latencies and error tendencies across a variety of tasks; studies of visual scanning strategies; studies of intervention designed to modify impulsive or reflective behaviors; studies assessing the effects of stress or anxiety; studies attempting to relate the reflection-impulsivity dimension to broader areas of interest (Block, Block, & Harrington, 1974).

## Studies of Generality

Correlations between response times on the MFF and the Haptic Visual Matching test (HVM) were found to be high across samples of children in grades one through three (Kagan, 1965a). The median correlation coefficient was .64.

Intertask correlations for MFF, HVM, and the Delayed Recall of Designs test (DRT), on response times, have ranged from .30 to .60. Average response time on one task was found to be predictive of both time and errors on a second task (Kagan, 1966a). Further evidence for this generality has been illustrated in situations where subjects had to generate alternatives or answer questions in an interview situation (Kagan, 1965a).

Impulsive children were more likely to make commision errors on a serial-recall task than were reflective children (Kagan, 1966a). Reflective and impulsive children, third graders, were given a serial learning task under three different conditions: a threat condition, rejection condition, and a control condition. Following the administration of two word lists, subjects under the threat condition were told that subsequent lists were more difficult. The subjects in the rejection groups were told that their performance was poor; subjects in the control group were given no special instructions. Overall findings indicated that impulsive children in all conditions reported more incorrect words before and after experimental manipulations were imposed.

Impulsive children made more mistakes while reading prose than did reflective children (Kagan, 1965c). One hundred thirty children were given visual matching problems involving designs, pictures, and reading recognitions tasks at the end of first and second grades. The MFF was used to

classify the subjects as to their reflection-impulsivity. In the letter recognition task, each letter of the alphabet was presented to the subject on a three by five card and then asked to label the letter shown. Presentations were random. If a mistake were made, the subject was told the correct answer. In the word recognition task, the subject was given a card with five words printed on it. He was then asked to point to the word read by the experimenter. As expected, impulsive subjects made more errors than reflective subjects. Verbal ability was predictive of quality; however, the relation between a reflective disposition and errors remained significant after verbal skill ability had been partialled out, partial $r$ = .28 (p .05).

The quality of inductive reasoning has also been shown to be related to reflection-impulsivity (Kagan, Pearson, and Welch, 1966a). In this study, first grade children were administered the MFF and HVM to determine their conceptual tempo. A picture completion reasoning task, extrapolation reasoning task and a guessing game comprised the inductive reasoning tasks. Subjects classified as reflective committed fewer errors and had longer response times on the reasoning tasks than impulsives.

In sum, children who are faster and commit more errors on the MFF, when contrasted with children who are slow and accurate, tend to make more errors and generally

show shorter response latencies in tasks involving a choice among several possibilities.

Studies of Visual Scanning Strategies

Siegelman (1969) has studied the observing behaviors of reflective and impulsive fourth-grade boys. Initial MFF testing determined the children's conceptual tempos. Administration of the MFF was modified for a second testing session during which the observing behaviors of subjects were recorded. The standard and its variants was mounted on a wooden panel. By pressing a button, subjects could focus either on the standard or on one of its variants. Only one button could be pressed at a time; the time factor was self-determined.

> As predicted, reflective subjects had significantly higher mean scores on all absolute measures of frequency and duration of looking behavior. But when relative deployment of attention was calculated, reflective subjects, as compared to impulsives, were found to devote proportionately less looking . . . to the standard (abstract).

Impulsive subjects ignored approximately twice as many comparison alternatives.

Ault, Crawford and Jeffrey (1972) recorded visual scanning strategies of 9-year-old subjects as the MFF was administered. Reflective subjects were more systematic and made more comparisons than did impulsive subjects. However, all groups used the same basic strategy for making comparisons. In a similar study, Zelniker, Jeffrey, Ault and

Parsons (1972) found indications that impulsive subjects had a poorer ability to sustain attention.

Studies Involving the Modification of Conceptual Tempo

The results of these studies were not conclusive. Kagan (et al., 1966b) attempted to train reflectivity by requiring subjects to inhibit their responses for fifteen seconds. Although the delayed response time generalized to a new setting and a new experimenter, there were no significant differences in error scores. Nelson (1969) found that a program emphasizing only accuracy produced fewer errors and longer response times in impulsive children. In another study, Yando and Kagan (1968) randomly assigned children teachers classified as impulsive or reflective in an attempt to examine the influence of a preferred teaching style on first grade students. The children were administered the MFF in the fall and again the following spring. Changes in reflection-impulsivity scores were related to the tempo of the teacher.

Studies Assessing the Effects of Anxiety

Messer (1970) introduced an anxiety factor by having subjects fail in an intellectual task. He hypothesized this would influence the tempo in a problem-solving task. The anxiety resulted in increasing the response latencies for reflective and impulsive children. There was also a

decrease in the number of errors committed by impulsive children whose response time increased.

Ward (1968) analyzed individual item delays on the MFF as a function of success or failure on the preceding item. Results indicated that impulsive subjects increased their response time significantly after failing an item.

Studies Implementing the Reflective-Impulsive Dimension

Neussle (1972) investigated the influence of reflective and problem-solving styles on the information-processing proficiency of fifth and ninth graders.

> It was concluded that developmental differences in focusing are related to the developmental differences in reflection-impulsivity. An examination of the Levine task revealed the likelihood that a reflective cognitive style facilitates focusing because it allows for more effective retrieval and recoding of information (abstract).

Adams (1972) administered a probability learning task to six- and eight-year-old children, classified as reflective or impulsive by the MFF Test, to examine the different strategies exhibited by reflective and impulsive children. To determine the maturity of these strategies, Adams compared his data to Weir's 1964 problem-solving strategy norms. Results indicated that young reflective subjects exhibited a performance level more closely to the one exhibited by seven- to nine-year olds, whereas young impulsive subjects exhibited a performance level more similar to his own age group, the five- to seven-year-old sample.

Conceptual tempo seemed to have little influence on the older children; both reflective and impulsive children performed similarly when compared with the seven- to nine-year-old norms.

McKinney (1973) compared the strategies of reflective and impulsive second graders on a matrix-solution task.

> Each subject solved three problems, and each solution was scored as an instance of one of four categories. A focusing strategy was defined as testing one stimulus attribute on each informative trial. A scanning strategy was defined as testing one stimulus at a time in an orderly fashion, and a random strategy was scored when the subjects tested specific stimuli without following a discernible pattern. A mixed strategy was defined as any combination of the three basic approaches (p. 1045).

Seventy-four percent of the reflective subjects used a focusing strategy, as compared to 34 percent of the impulsive subjects. Fifty-six percent of the impulsive subjects exhibited a random or a mixed strategy, whereas only 26 percent of the reflective subjects did. Reflectives were found to extract more information than the impulsives ($p < .05$). This data provided further evidence that reflective children seem to consider alternatives and use more efficient problem-solving strategies than the impulsive children.

Siegel, Kirasic and Kilburg (1973) demonstrated that reflective children perform better on a recognition memory task than impulsive children. Twenty-four preschool children were assigned to one of four experimental conditions.

Responses could be based on verbal labeling, visual analysis, or both. Condition I consisted of pairing the original stimuli with a new object; condition II, of pairing the original stimuli with one differing from it only in a minor detail. In condition III, the original stimulus was paired with a same-name stimulus with distinct differences. Condition IV had two completely new stimuli, one of which was similar to the original on a name-basis only. Under all four conditions reflective subjects performed better.

Block, Block and Harrington (1974) examined the discrepancy existing between the conceptualization of reflection-impulsivity (emphasizing decision latency) and its operationalization (which adds the accuracy variable). Separate contributions of response latency and accuracy were evaluated. In a sample of 100 children, accuracy had appreciable implications for personality implications; however, response time had slight contributions unless it interacted or served as a function of the accuracy measure.

# CHAPTER III

## METHOD

### Subjects

The subjects were 48 children, 24 in each of grades one and four, selected from a public elementary school in Greensboro, North Carolina. Mean chronological ages for the children were 7.1 years and 10.3 years for grades one and four, respectively. The children were described by the school principal and the teachers to have average intellectual ability and to represent families of middle-class income and occupational levels.

Forty-six first graders and 48 fourth graders were administered the MFF in order to obtain a sample of 12 reflective and 12 impulsive children at each grade level to achieve a total sample of 48 children. A double median-split criterion for each grade level based on response time and the number of erroneous choices defined reflective-impulsive behavioral dispositions at each grade level. The means and standard deviations of the time and error data collected from all children who were administered the MFF are shown in Table 1. Mean time and mean number of errors of those subjects identified as reflective or impulsive at each grade level are shown in Table 2. The correlation

Table 1

Means and Standard Deviations of Mean Time per Item and Total Errors for All Subjects Administered the MFF Prior to Selection of Subjects for the Sorting-Recall Task (Total N = 94)

| Grade | Time $\bar{X}$ | Time SD | Errors $\bar{X}$ | Errors SD |
|---|---|---|---|---|
| One (N = 46) | 13.68 | 7.94 | 15.37 | 6.02 |
| Four (N = 48) | 10.29 | 6.98 | 12.66 | 4.29 |

Table 2

Means of Mean Response Time and Errors of Subjects Identified as Reflectives and Impulsives who were Administered the Experimental Sorting-Recall Task (Total N = 48)

| | Reflectives | | Impulsives | |
|---|---|---|---|---|
| Grade | $\bar{X}$ Time | $\bar{X}$ Errors | $\bar{X}$ Time | $\bar{X}$ Errors |
| One (N = 24) | 24.33 | 10.17 | 7.22 | 22.08 |
| Four (N = 24) | 15.65 | 6.67 | 6.60 | 14.25 |

between the time and error measures of the MFF for the experimental sample of 48 children was .62.

Design and Materials

Each of the children in the sample was administered the Matching Familiar Figures test (MFF, children's form, Kagan, 1965) in order to identify the reflective and impulsive children across grade levels. According to McKinney and Haskins (1974) it was assumed that between 60-70 per cent of the children at each grade would be classified as either reflective or impulsive. Hence, the initial administration of the MFF to the total sample yielded 12 reflective and 12 impulsive children at each grade level. Those children identified by the MFF to be reflective or impulsive were administered the sorting and recall task approximately one week after the MFF testing.

The sorting-recall task was conducted in a manner in which the subject was presented with an array of color picture cards and was asked to sort the pictures into a self-determined number of categories comprised of pictures the subject deemed "goes best" with one another. Immediately following the sorting task, the pictures were removed from the subject's view and the subject was then asked to freely recall the names of the pictures. Sorting trials continued until the subject reached a stable sorting scheme, that is, identical sorting schemes on two successive sorting trials.

Stimulus pictures were selected from the color picture cards included in the Ginn pre-reading kit B. The array for the fourth grade subjects was comprised of 20 pictures. First graders received an array of 14 of the pictures shown to the fourth graders. These pictures were selected from lists used by Rosner (1971, 1974) which were constructed so that associative, conceptual, and perceptual relations among the items were minimal. The number of items used for the subjects at these two grade levels was determined after the inspection of the ceiling levels of free recall data previously reported in studies of children's free recall.

The pictures and their frequencies in children's literature (Thorndike-Lorge, 1941) for the first grade list were as follows: coat (AA), saw (AA), book (AA), matches (A), wagon (A), basket (A), cup (A), fence (A), doll (44), watch (AA), deer (35), towel (18), piano (26), and fan (38). The following six items were added to comprise the fourth grade list: heart (AA), cake (A), moon (AA), football (26), ladder (19), and leaf (27).

## Tasks and Procedure

The following tasks described were administered according to the procedure outlined.

Matching Familiar Figures
Test Administration

Each child in the total sample of 94 was administered the MFF which consisted of two practice sets and twelve test sets. Each child was administered the MFF individually while seated at a table beside the experimenter. To assure that the standard stimulus and response alternatives were simultaneously available to the subject (i.e., in the child's view), the booklet was held at right angles to each other. The standard directions for administering the MFF were as follows:

> "I am going to show you a picture of something you know and then some pictures that look like it. You will have to point to the picture on this bottom page (point) that is just like the one on this top page (point). Let's do some for practice." E shows practice items and helps the child to find the correct answer. "Now we are going to do some that are a little bit harder. You will see a picture on top and six pictures on the bottom. Find the one that is just like the top and point to it."
>
> E will record latency of first response to the half-second, total number of errors for each item, and the order in which the errors are made. If S is correct, E will praise. If wrong, E will say, "No, that is not the right one. Find the one that is just like this one (point)." Continue to code responses (not times) until child makes a maximum of six errors or gets the item correct. If incorrect, E will show the right answer (Kagan, 1965).

Sorting-Recall Task Administration

Approximately one week after the MFF administration, those subjects at each grade level identified as reflective and impulsive in conceptual tempo were administered the

sorting-recall task. The child was ushered into the testing room, individually, and seated next to the experimenter before a table. A table cover partitioned into six squares of equal size was used to aid the subject in positioning their sorting categories. The experimenter explained that she was interested in how children of different ages remember the things they see and for this reason the child was to perform a memorizing task. At this point the experimenter showed the subject a practice set of eight black and white pictures bearing no obvious relation to those in the experimental set. The practice set was intended to familiarize the subjects with the requirements of free recall. The experimenter spread out the practice set in one row and said:

> "__(Child's name)__, I am interested in finding out how children in different grades in school remember the things they see. I am going to show you some pictures and ask you to remember as many as you can in any order that you can. Say the names of these pictures."

After the subject named each picture correctly, the subject was given 45 seconds to view the pictures, after which the child was asked to sort according to the instructions used for the experimental task. The experimenter then removed the pictures from the child's view, and the subject was told he could remember the pictures in any order that he chose. A color naming task was employed between the viewing and recall phases of the task. This distractor task was used to

discourage the child from relying on rote means of recall (e.g., verbal rehearsal).

Following the free recall of the practice set the experimenter told the subject:

> "Now I am going to show you some more pictures. Just like the other task at the end I will ask you to remember as many as you can in any order that you like. Say the names of these pictures."

After the child successfully named each of the experimental pictures, the experimenter said the following:

> "This time I am going to ask you to make groups out of pictures before you try to remember them. I want you to put the pictures that you think should go together next to each other in the same square. There are many ways that the pictures could go together. You have to decide which pictures you think go together the best. You do not have to use all the squares. In fact, you can use as many of the squares as you want to as long as you use more than one square. When you want to begin a new group, put the first picture of that new group in one of the empty squares. Try to think carefully when making your groups so that you can make the same ones the next time I ask you."

The subject was asked if that was the way he wanted his group, giving him the option to make any changes. Once the subject finished the first sorting trial, the experimenter shuffled the pictures and spread them out in a new random arrangement for a second sorting trial. The experimenter then said:

> "Now I want you to make your groups again with the same cards. Remember to think carefully so that you will be able to make the same groups again when I ask you."

The sorting trials continued until the subject reached a stable sorting scheme on two successive trials. At the end

of the last sorting trial, the subject was administered a color naming task requiring approximately 20 seconds of time, after which he was asked to verbally recall the pictures in any chosen order.

Following the free-recall task, the experimenter put the first picture of each category in its appropriate square. He then said to the subject:

> "Now let's put the cards back together the way you had them. If you had a reason for putting the pictures together, tell me why."

The experimenter recorded the explanations for the groupings, if there were any given, while the subject reconstructed his categories.

## Dependent Measures

During each sorting trial, the experimenter recorded which items the subject placed in each of his sorting categories. From these data the experimenter determined the number of sorted categories as well as the mean size of each category. The experimenter also recorded the time taken for each sorting trial. Following the free recall task the subject was asked to reconstruct his sorting categories and to give his sorting rationales, i.e., to explain his reasons for including items in categories. Sorting rationales were scored on the basis of their descriptive, similarity, and complementarity content according to criteria set forth by Denny and Ziobrowski (1972).

From the recall data the following measures were analyzed: the number of items recalled; the amount of recall clustering; the percentages of items recalled from each category; and the percentages of the categories recalled.

# CHAPTER IV

# RESULTS

The purpose of this chapter was to present the results of the study for the 48 subjects who were administered the free sorting and free recall tasks. Since subjects at grade level one and four received different number of stimulus items for sorting and recall, the subjects' recall scores were converted to proportions of items correctly recalled to permit grade level comparisons. All statistical analyses of the recall and clustering data were performed on transformed arcsin measures.

## Recall Performance of Reflective and Impulsive Children

The percentage of stimulus items correctly recalled by the subject during free recall constituted the subject's recall score. Means and standard deviations of these percentage scores are shown in Table 3. A two factor analysis of variance performed on the transformed recall scores yielded significant main effects for grade level, $F$ (1, 44) = 24.4692, $p < .001$, and for conceptual tempo, $F$ (1, 44) = 9.3135, $p < .005$. The grade x conceptual tempo interaction was not significant, $F$ (1, 44) = 0.0692, $p > .05$.

Table 3

Means and Standard Deviations of Percentage Recall Scores for Experimental Subjects (N = 12 per cell mean)

| Grade | Reflectives $\bar{X}$ | Reflectives SD | Impulsives $\bar{X}$ | Impulsives SD |
|---|---|---|---|---|
| One | 63.0833 | 5.08 | 50.5833 | 4.01 |
| Four | 86.6666 | 3.83 | 75.0000 | 4.00 |

## Recall Clustering Performance of Reflective and Impulsive Children

Item clustering index (ICI) scores (Robinson, 1966) were calculated according to the formula ICI = r/c (Wc - 1), where r = the total number of repetitions in recall, c = the number of categories represented by the items recalled, and Wc = the number of items in each category. Since category size varied for the subjects in the present study, Wc represented the mean number of items in the subject's categories. The ICI measure is a ratio of the number of clustered pairs observed to the total number possible; therefore, it is expressed in percentage form and can range from 0.00 to 1.00. A score of 0.0 represented no clustering of the possible number of pairs during free recall (i.e., no tendency to recall items of the same sorting categories together during recall) and a score of 1.0 represented perfect clustering of the possible number of pairs during free

recall. Means and standard deviations of these percentage recall clustering scores are shown in Table 4.

Table 4

Means and Standard Deviations of Percentage Recall Clustering Scores for Experimental Subjects (N = 12 per cell mean)

| Grade | Reflectives $\bar{X}$ | Reflectives SD | Impulsives $\bar{X}$ | Impulsives SD |
|---|---|---|---|---|
| One | 72.0833 | 8.67 | 28.750 | 6.88 |
| Four | 73.0833 | 4.25 | 55.666 | 5.55 |

A two factor analysis of variance performed on the arcsin transformed recall clustering scores yielded significant main effects for grade level, $F$ (1, 44) = 5.3653, $p < .05$, and for conceptual tempo, $F$ (1, 44) = 9.1095, $p < .005$. The grade x conceptual tempo interaction was not significant, $F$ (1, 44) = 2.5408, $p > .05$.

## Relationships Between Recall and Clustering Among Reflective and Impulsive Children

To assess the degree to which clustering may have enhanced recall performance Spearman Rank-Order Correlation analyses were calculated between the subjects' transformed recall and transformed clustering scores. Results, collapsed across the conceptual tempo variable, indicated a significant relationship between recall and clustering for

the total sample, $r$ (46) = .66, $p < .001$, as well as for the first grade sample, $r$ (22) = .67, $p < .001$, and the fourth grade sample, $r$ (22) = .38, $p < .05$. The lower relationship found at the fourth grade level appeared to be attributed to reflective, as opposed to impulsive, subjects. Whereas, impulsive fourth grade children displayed a highly significant relationship between recall and clustering, $r$ (10) = .71, $p < .001$, fourth grade reflectives displayed no relationship between the two performance measures, $r$ (10) = -.08, $p > .05$. This discrepancy between reflective and impulsive children was not apparent at the first grade level. In this age group, the coefficients were significant for both reflective, $r$ (10) = .67, $p < .001$, and impulsive, $r$ (10) = .68, $p < .001$, children. A difficulty in interpreting the relationship between organization and recall among fourth grade reflectives concerned a lower degree of variability in these subjects' recall scores, i.e., from 15-20 items. With such a restricted range of variability it would be difficult to detect a positive relation if, in fact, one did exist.

## Relative Contributions of the Time and Error Dimensions of Conceptual Tempo to Recall Clustering Performance

In an attempt to determine how response time and error dimensions of conceptual tempo contribute both independently and jointly to the subjects' recall and clustering

performance, multiple regression analyses were used to test the relationships between the subjects' response time and errors on the MFF with the transformed recall and clustering data. Single and multiple $r$'s derived from these analyses are shown in Table 5. Although response time was marginally related to the recall performance of fourth grade subjects ($r = .43$, $p < .05$) this variable was not a significant contributor to either of the performance measures of first graders ($r = .27$) or of the total sample ($r = .10$). However, the error variable was significantly related to the subject's recall performance at grade level one ($r = .51$, $p < .05$) and grade level four ($r = .46$, $p < .05$), as well as for the total sample when collapsed across grade levels ($r = .61$, $p < .01$). The error measure was also significantly related to the subject's clustering performance at grade level one ($r = .59$, $p < .01$) and for the total sample ($r = .55$, $p < .01$). The error variable was not significantly related to the fourth graders' clustering performance ($r = .23$, $p > .05$).

Statistical z-test comparisons yielded no significant differences at any grade level between the magnitude of the single correlation coefficients relating MFF error scores to recall and clustering performance and the magnitude of the multiple coefficients relating the combination of MFF time and error scores to recall and clustering performance. Thus, it appears that the MFF response time measure did not

Table 5
Single and Multiple Correlation Coefficients Between Subjects' Response Times and Errors on the MFF with Recall and Clustering Performance in the Free Recall Task
(Based upon transformed data scores)

| Variable | Grade 1 (N = 24) | | Grade 4 (N = 24) | | Total Sample (N = 48) | |
|---|---|---|---|---|---|---|
| | Recall | Clustering | Recall | Clustering | Recall | Clustering |
| Time | .27 | .29 | .43* | .33 | .10 | .19 |
| Errors | .51* | .59** | .46* | .23 | .61** | .55* |
| Time + Errors | .59** | .70** | .48* | .33 | .68** | .57** |

*$p < .05$
**$p < .01$

prove to be a significant contributor to the subjects' recall and clustering performance.

## Sorting Behaviors Exhibited by Reflective and Impulsive Children

Developmental data on the four measures associated with the subjects' free sorting task performance (i.e., number of trials to stable sorting criterion, mean time per sorting trial, number of categories utilized on the final sorting trial, and mean category size) are shown in Table 6. Two factor analysis of variance performed on the number of trials required to reach stable sorting criterion yielded significant main effects for grade level, $F$ (1, 44) = 7.5804, $p < .01$, and for conceptual tempo, $F$ (1, 44) = 6.6034, $p < .05$. The grade x conceptual tempo interaction was not significant, $F$ (1, 44) $= < 1$. A two factor analysis of variance performed on the mean time per trial data yielded significant main effects for grade level, $F$ (1, 44) = 10.9223, $p < .005$, and for conceptual tempo, $F$ (1, 44) = 15.5471, $p < .001$; however, grade x conceptual tempo interaction did not approach statistical significance, $F$ (1, 44) $= < 1$.

Two analyses of variance were performed on the number of sorting categories used by subjects on the final sorting trial and on the mean category size data. For the number of sorting categories measure the analysis yielded a significant main effect for grade, $F$ (1, 44) = 7.00, $p < .05$. No

Table 6

Mean Performance Scores of Reflective and Impulsive Children on Four Measures Related to the Free Sorting Task

| Measure | Grade 1 (N = 24) Reflectives | Grade 1 (N = 24) Impulsives | Grade 4 (N = 24) Reflectives | Grade 4 (N = 24) Impulsives |
|---|---|---|---|---|
| No. of trials to stable sorting criterion | 4.0833 | 5.250 | 2.833 | 4.00 |
| Mean time per sorting trial (sec.) | 155.742 | 80.608 | 211.708 | 144.20 |
| No. of categories on final sort | 5.0 | 5.5 | 6.0 | 5.6 |
| Mean category | 3.216 | 2.608 | 3.299 | 3.533 |

significant effects were found for conceptual tempo, $F$ (1, 44) = $<$1, or for the grade x conceptual tempo interaction, $F$ (1, 44) = 3.6, $p > .05$. An analysis of variance performed on the mean category size measure yielded a significant main effect for age, $F$ (1, 44) = 7.0149, $p < .05$, but not for conceptual tempo, $F$ (1, 44) = $<$ 1. The grade x conceptual tempo interaction was significant in this analysis, $F$ (1, 44) = 4.8876, $p < .05$. To clarify the nature of this interaction, Least Significant Difference Tests (LSD) were computed between the age groups for reflective and impulsive children independently. These tests indicated no statistically significant differences between the mean category size of reflective first and fourth graders ($p > .05$). However, first grade impulsive subjects exhibited significantly smaller sorting categories than fourth grade impulsives ($p < .05$).

## Influences of the Children's Sorting Behaviors on Recall and Clustering Performance

To determine whether the recall and clustering differences between reflective and impulsive children could be accounted for by differences in their attentional behaviors during the task's presentation phase, i.e., during the pre-recall sorting session, the subjects' mean sorting time and number of sorting trials required to reach criterion were combined to function as a single covariate in analyses of

covariance performed on the transformed recall and clustering data. For the recall data, the analysis yielded a significant main effect for grade level, $F$ (1, 42) = 13.07, $p < .001$, but no significant main effect for conceptual tempo, $F$ (1, 42) = 3.5, $p > .05$. The analysis yielded a nonsignificant grade x conceptual tempo interaction, $F$ (1, 42) $< 1$. For the clustering data the analysis of covariance yielded nonsignificant results for grade level, $F$ (1, 42) $< 1$, for conceptual tempo, $F$ (1, 42) = 1.8, $p > .05$, and for the grade level x conceptual tempo interaction, $F$ (1, 42) = 2.5, $p > .05$. Thus, it appears that differential recall performance between reflective and impulsive children sampled here can be accounted for by the variables mean sorting time and the number of sorting trials required to reach the stable sorting criterion--measures presumed to reflect the degree to which subjects are actively attentive during the task.

## Relationships Between Conceptual Tempo and the Children's Behaviors in the Free Sorting Task

Spearman Rank-Order Correlational analyses were performed between the time and error measures of the subjects' MFF performance and selected measures of sorting behavior. The analyses were performed for the total samples, first grade level and fourth grade level. Summaries of the data are presented in Tables 7, 8, and 9, respectively.

Table 7

Spearman Rank-Order Correlation Coefficients Between Measures of the MFF, the Free Sorting Task, and the Recall and Clustering Performance Measures (Total Sample, N = 48)

| Variables | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | 1.00 | -.62*** | .50*** | -.17 | .17 | .27 |
| 2 | - | 1.00 | -.55*** | .41** | -.62*** | -.50*** |
| 3 | | - | 1.00 | -.52*** | .50*** | .50*** |
| 4 | | | - | 1.00 | -.43*** | -.35 |
| 5 | | | | - | 1.00 | .66*** |
| 6 | | | | | - | 1.00 |

*p < .05
**p < .01
***p < .001

Variable 1 = MFF Time
Variable 2 = MFF Error
Variable 3 = Mean Sorting Time per Trial
Variable 4 = No. of Sorting Trials to Criterion
Variable 5 = Transformed Recall Data
Variable 6 = Transformed Clustering Data

Table 8

Spearman Rank-Order Correlation Coefficients Between Measures of the MFF, the Free Sorting Task, and the Recall and Clustering Performance Measures (First Grade, N = 24)

| Variables | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | 1.00 | -.77*** | .75*** | -.15 | .9 | .29 |
| 2 | - | 1.00 | -.67*** | .32 | -.49** | -.55** |
| 3 | | - | 1.00 | -.38* | .31 | .39* |
| 4 | | | - | 1.00 | -.36* | -.21 |
| 5 | | | | - | 1.00 | .67*** |
| 6 | | | | | - | 1.00 |

*p < .05
**p < .01
***p < .001

Variable 1 = MFF Time
Variable 2 = MFF Error
Variable 3 = Mean Sorting Time per Trial
Variable 4 = No. of Sorting Trials to Criterion
Variable 5 = Transformed Recall Data
Variable 6 = Transformed Clustering Data

Table 9

Spearman Rank-Order Correlation Coefficients Between Measures of the MFF, the Free Sorting Task, and the Recall and Clustering Performance Measures (Fourth Grade, N = 24)

| Variables | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | 1.00 | -.75*** | .59*** | -.41* | .42* | .42* |
| 2 | - | 1.00 | .59*** | .30 | -.47* | -.16 |
| 3 | | - | 1.00 | -.57** | .33 | .49** |
| 4 | | | - | 1.00 | -.26 | -.37* |
| 5 | | | | - | 1.00 | .38* |
| 6 | | | | | - | 1.00 |

*p < .05
**p < .01
***p < .001

Variable 1 = MFF Time
Variable 2 = MFF Error
Variable 3 = Mean Sorting Time per Trial
Variable 4 = No. of Sorting Trials to Criterion
Variable 5 = Transformed Recall Data
Variable 6 = Transformed Clustering Data

For the correlation analyses of the total sample's data, the MFF time variable was significantly correlated with the MFF error variable, $r$ (46) = -.62, $p < .001$, and the mean time per sorting trial, $r$ (46) = .50, $p < .001$. No significant correlations were found between the MFF time measure and the number of sorting trials to stable criterion, the amount of recall, or the extent of recall clustering. The MFF error variable was significantly correlated with mean sorting time per trial, $r$ (46) = .59, $p < .001$, number of sorting trials to criterion, $r$ (46) = .41, $p < .01$, amount of recall, $r$ (46) = -.62, $p < .001$, and amount of clustering, $r$ (46) = -.50, $p < .001$. The mean sorting time per trial measure was significantly related to the number of sorting trials to criterion, $r$ (46) = -.52, $p < .001$, as well as the recall and clustering data, $r$ (46) = .50, $p < .001$, for both variables. The number of sorting trials to criterion measure was significantly correlated with amount of recall, $r$ (46) = -.43, $p < .001$, but not with amount of clustering, $p > .05$. The transformed recall and clustering data were significantly correlated, $r$ (46) = .66, $p < .001$.

Correlational analyses performed on the first graders data yielded similar findings. The MFF time variable was significantly correlated with the MFF error variable $r$ (22) = -.77, $p < .001$, and the mean sorting time per trial $r$ (22) = .75, $p < .001$. No significant correlations were found between MFF time and the number of trial to criterion,

the recall or the clustering data. The MFF error variable was significantly correlated with mean sorting time per trial, $r$ (22) = -.67, $p < .001$, transformed recall data, $r$ (22) = -.49, $p < .01$, and transformed clustering data, $r$ (22) = -.55, $p < .01$. There was no significant correlation between MFF error and the number of sorting trials to criterion. Mean sorting time per trial was significantly correlated with number of sorting trials to criterion, $r$ (22) = -.38 $p < .05$, and the clustering data, $r$ (22) = .39, $p < .05$; however it was not significantly correlated with the recall data, $p > .05$. The number of sorting trials to criterion measure was significantly correlated with the recall data, $r$ (22) = -.35, $p < .05$, but not with the clustering data, $p > .05$. Transformed recall and clustering measures were significantly correlated, $r$ (22) = .67, $p < .001$.

Correlational analyses performed on the fourth graders data indicated that the MFF time variable was significantly correlated with MFF error variable, $r$ (22) = -.75, $p < .001$, the mean sorting time per trial, $r$ (22) = .59, $p < .001$, the number of sorting trials to criterion, $r$ (22) = -.41, $p < .05$, the transformed recall data, $r$ (22) = .42, $p < .05$, and the clustering data, $r$ (22) = .42, $p < .05$. The MFF error variable was significantly correlated with the mean sorting time per trial variable, $r$ (22) = .59, $p < .001$, and the recall data, $r$ (22) = -.47, $p < .05$. It was not statistically significant with either the number of sorting trials to

criterion measure, $p > .05$, or the clustering data, $p > .05$. Mean sorting time per trial was found to be statistically significant when correlated with the number of sorting trials to criterion, $r$ (22) = -.57, $p < .01$, and with the clustering scores, $r$ (22) = .49, $p < .01$. It was not significantly correlated with the recall scores, $p > .05$. The number of sorting trials to criterion measure was significantly correlated with the clustering data, $r$ (22) = -.37, $p < .05$, but not the recall data, $p > .05$. Recall and clustering scores for the fourth grade level were significantly correlated, $r$ (22) = .38, $p < .05$.

# CHAPTER V

## DISCUSSION

The general purpose of the present investigation was to examine selected aspects of retention performance exhibited by young school age children who were known to differ in conceptual tempo as defined by the MFF Test. The results of the study were discussed in reference to the hypotheses. To examine the relationship between the children's retention performance and their classification on the conceptual tempo dimension, a pre-recall free sorting task was used as a stimulus presentation procedure. The sorting task yielded performance measures, e.g., sorting times, number of trials to successful (stable) sorting, assumed to reflect the degree to which the subject was attentive to the meaningful properties of the stimuli. In the study it was expected that children characterized to possess an impulsive conceptual tempo would be less attentive to the meaningful relationships existing between the stimuli, and thereby, show poorer levels of free recall and recall organization (i.e., clustering) than reflective subjects. It was further reasoned that these performance differences would be evident in analyses of free sorting behaviors. That is, impulsive children would exhibit less attention, and thereby, less

time in sorting the stimuli into meaningful groupings. Consequently, impulsive children would require a greater number of sorting trials to achieve a stable set of sorting categories.

The first three hypotheses dealt with grade level comparisons; hypotheses one and two were concerned with the behavioral sorting measures while hypothesis three pertained to recall and clustering performance. Previous research has shown that younger children sort into smaller categories than do older children and adults in a free sorting task (Annett, 1959; Goldman & Levine, 1963; Lange & Hultsch; Lange & Jackson, 1974; Liberty & Ornstein, 1973). Saltz and Siegel (1967) and Saltz, Soller, and Siegel (1972) have interpreted these findings to indicate that the concepts of younger children are more fragmented than those of older children. Thus, hypothesis (1) of the present study stated that older children would form larger sorting categories than younger children. As shown in Table 6, this expectation was supported for impulsive subjects but not for reflective subjects. An analysis of variance yielded a significant main effect for grade ($p < .01$), and a significant grade x conceptual tempo interaction ($p < .05$). Further analysis with Least Significant Difference test revealed no significant difference between first and fourth grade reflective subjects; however, first grade impulsive subjects constructed significantly smaller sorting categories than fourth grade

impulsives ($p < .05$). These findings suggest that it was the young impulsive children who tend to exhibit more fragmented concepts.

Based upon the findings of Lange and Hultsch (1970) and Lange and Jackson (1974), hypothesis (2) posited that older children would require fewer trials to establish stable sorting schemes than younger children. The reasoning underlying this hypothesis was that younger children were presumed to be less attentive to meaningful relations between stimuli, and therefore, failed to arrive at the same category schemes from trial to trial. This hypothesis was confirmed by a significant grade level effect in the analysis of variance of the number of sorting trials to criterion data (see Table 6). The age x conceptual tempo interaction in this analysis was not significant.

Previous research has shown that both recall and recall organization (i.e., clustering) increases with age (e.g., Cole et al., 1971; Horowitz, 1969; Lange, 1973). Hypothesis (3) of the present study stated that older children would show higher levels of clustering and higher levels of recall as a result of their clustering behaviors. Analysis of variance performed on both the recall and clustering data indicated significant grade level main effects in favor of fourth grade subjects ($p < .001$ and $p < .005$ for the recall and clustering measures, respectively). The grade x conceptual tempo interactions in these analyses

did not approach statistical significance ($p > .05$). As can be surmised from Table 3, first grade subjects recalled nearly 57 percent of their 14-item stimulus list, whereas, fourth graders recalled nearly 81 percent of their 20-item stimulus list. The children's clustering data summarized in Table 4 indicated that first graders clustered more than 50 percent of the potentially clusterable pairs of items, whereas, fourth graders clustered more than 64 percent of their total possible pairings.

Although the tendency to cluster has been shown to increase with age, there has been little evidence to suggest that children prior to nine and ten years of age organize their recall at above-chance levels. However, as has been pointed out earlier, clustering capabilities in these studies have been assessed in reference to experimenter-defined taxonomic categories, and may have underestimated true organizational abilities of younger children, i.e., those least likely to possess adult-like conceptual structures. Lange and Jackson (1974) employed a modification of Robinson's (1966) Item Clustering Index (ICI) in an attempt to more accurately assess young childrens' organizational capabilities. This index derives its clustering scores from categories determined by the subject. Consequently, Lange and Jackson reported high levels of clustering among first and fourth graders, 50 percent and 60 percent, respectively. The findings of the present study, which also employed the

modified measure of stimulus organization, provided clear support for the findings of Lange and Jackson. It was interesting to note the similarity of these findings in view of several differences between the procedures of the two studies. First, the present study varied list length for subjects, at the different grade levels, whereas Lange and Jackson did not. Secondly, the stimulus items used in the present study were deemed unrelated to one another, whereas Lange and Jackson used related stimulus items.

An additional similarity between the findings of the present study and those of Lange and Jackson concerned the relationship between recall and clustering. Using the subjects own sorting categories as referents for organization in children's recall, Lange and Jackson found relatively high correlations between amount of recall and amount of clustering among the first and fourth grade subjects. Previous developmental research using taxonomic categories predefined by the experimenter as referents for the children's recall organization have failed to detect significant relationships between these two measures among young children. In support of Lange and Jackson's findings, the present correlations between clustering and recall were .67 ($p < .001$) for first graders, and .38 ($p < .05$) for fourth graders. Thus, there was evidence from each of these studies that organization may have served to enhance retention among even the youngest of school age children.

The remaining hypotheses dealt with comparisons between subjects of differing conceptual tempo in reference to their sorting behaviors and their recall and clustering performance. Previous research concerned with the reflection-impulsivity dimension has indicated that impulsive children exhibit shorter response latencies in task settings which involve levels of response uncertainty. Research which has examined conceptual tempo with regard to attentional measures has found that impulsive children are less able to attend to task relevant information (Adams, 1972; McKinney, 1973). It was assumed that a subject must focus his attention on the presented stimulus items and the possible relationships between the items in order to perform efficiently. Hence, hypotheses (4) and (5) stated that impulsive children at each grade level would take less time during each sorting trial and would require more trials to reach stable sorting criterion. A significant main effect for conceptual tempo of the analysis of variance of the time per trial data (see Table 6) confirmed hypothesis (4) ($p < .001$). Analysis of variance performed on the number of trials to criterion data (see Table 6) yielded a significant main effect for conceptual tempo ($p < .05$). Since the grade x conceptual tempo interactions in these analyses did not approach significance it must be concluded that impulsive subjects, regardless of age, spent less time in establishing free sorting schemes,

and as a result, required more sorting trials to establish stable sorting schemes.

To this writer's knowledge there was no direct evidence bearing on the relationship between conceptual tempo and children's retention performance. However, given that impulsive children were assumed less attentive in cognitive tasks, an assumption that gains considerable support from the above-mentioned results, hypothesis (6) posited that the impulsive children at each grade level would show poorer levels of clustering, and hence, poorer levels of recall. This hypothesis was supported by significant main effects of conceptual tempo for both the clustering ($p < .005$) and recall ($p < .005$) measures in the corresponding analyses of variance.

To summarize the above findings which pertain directly to the hypotheses of the study, significant main effects of grade level were found for mean category size, the number of trials required to reach stable sorting criterion, and levels of clustering and recall. Significant main effects for conceptual tempo were found in analyses of mean sorting time per trial, the number of trials required to reach stable sorting criterion, and for the levels of clustering and recall. With the exception of the mean category size measure of the children's sorting behaviors, indicating an age-related increase in category size only for impulsive

children, none of the remaining age x conceptual tempo interactions were significant.

A major issue that could be explained in the present study concerned the reasons that impulsive and reflective subjects showed differential performance on measures of recall and clustering. Previous research indicated that reflective children showed more evidence than impulsives to develop systematic strategies, and to confine their attention to task relevant cues (Adams, 1972; McKinney, 1973). Consequently these children showed poorer performance in cognitive tasks. It was assumed for the purposes of the present study that certain characteristics of the children's sorting performance would be indicative of their conceptual tempo disposition, and thus, their ability to attend to meaningful properties of the stimuli for the purpose of successful retention. It was expected that performance differences in organization and retention would result from the subjects failure to attend carefully during the presentation period. As indicated earlier, impulsive children required less time in sorting the items, but more trials to achieve stable sorting schemes. To determine whether these indices did account for poorer retention performance among impulsive children, the sorting time and number of trials measures were combined and used as a single covariable in grade level x conceptual tempo analyses. Analysis of covariance performed for the recall data yielded a main effect for grade

level ($p < .001$), but no main effect for conceptual tempo or for the grade x conceptual tempo interaction ($p > .05$). Analysis of covariance for clustering yielded no main effects or interactions ($p > .05$). Thus, it appeared that the effects of conceptual tempo could be accounted for by differences in children's attentional dispositions during cognitive task performance.

Most of the results thus far discussed in this section refer to reflective and impulsive children classified according to conventional MFF research. That is, a double median-split was performed on the latency and error measures. Subjects were then assigned to appropriate quadrants for further analyses. Block et al. (1974) pointed out that by using this technique continuous scores were dichotomized, and therefore, a loss of discrimination resulted. In an attempt to overcome this limitation, he related latency and error measures independently to various personality measures. It appeared that the error measure more accurately assessed relationships of personality attributes. In fact, response time was only significant when interacting or serving as a function of accuracy.

To examine the relative contribution of the time and error variables of conceptual tempo with the recall and organization (i.e., clustering) performance, single and multiple regression analyses were performed. The findings support those of Block et al.; that is, the error variable

appeared to contribute most significantly to recall ($p < .01$) and clustering ($p < .05$) scores for the total sample as opposed to the time measure which was not in and of itself significantly correlated.

## Subjects' Explanations for Their Sorting Categories

Immediately following the experimental sorting-recall task, the experimenter placed one picture of each of the subject's sorting categories on the table and asked the subject to reconstruct the categories and explain his reasons for including the remainder of items in each category, e.g., "Why did you put the matches, fan, and saw together in this group?" Based upon a coding system developed by Denney and Ziobrowski (1972), each of the subjects' sorting rationale was scored on the basis of "similarity," "complementarity," and "descriptive" criteria. Similarity explanations were those relating stimuli on the basis of membership in the same generic class (e.g., ball and wagon because they are toys). Complementarity explanations were those relating stimuli on the basis of functional or contextual relationships (e.g., book and pencil because I can write in the book with the pencil). Descriptive explanations were those referring to observable aspects of the stimuli (e.g., pencil and ladder because they are both long and thin).

Denney and Ziobrowski found that with an increase in age there was an increase in the use of similarity concepts

and a decrease in complementarity concepts. With similar criteria, Lange and Jackson found essentially the same age trend, i.e., from complementarity criterion to one of similarity with very few descriptive rationale.

An informal inspection of the sorting rationale given by the present subjects suggests the same conceptual-age trend found by the above-mentioned investigators. Approximately 80 percent of the sorting explanations given by first graders were based on complementary relationships, whereas a slight majority of the explanations given by the present fourth graders were based on similarity relationships. Only one subject gave a descriptive rationale. Another interesting finding of the present data concerned the number of reflective and impulsive subjects giving verbal explanations for their construction of sorting schemes. Among the first graders, seven of 12 impulsives were unable to provide explanations for any of their groupings, as compared to only three of the 12 reflectives. Among fourth graders, five impulsive children were unable to give reasons for all of their sorting categories, whereas, all of the reflective children verbalized reasons for all of their sorting categories. Whether this finding indicates the impulsive child's failure to employ verbal criteria in organizing his learning, or simply his inability to verbalize to an experimenter his criterion, remains unclear and should be pursued in furture research.

## Summary Statement

The present findings provided information about developmental differences in sorting and recall, and examined the influence of an individual difference dimension, conceptual tempo, upon performance in sorting and recall. Analyses revealed that younger children formed smaller sorting categories than older children and required more time in doing so. The findings corroborated those of previous developmental investigations of free classification and recall (Mandler & Stevens, 1967; Lange & Hultsch, 1970; Lange & Jackson, 1974). In addition, relatively high correlations between the amount of clustering and amount of recall were found for first and fourth graders, thus indicating, as did Lange and Jackson (1974), that organization appears to mediate recall achievements of children of both age levels.

Results indicated that conceptual tempo may serve to influence the performance of elementary school age children in a sorting-recall task. It appears that impulsive children were deficient, relative to their reflective counterparts, both in organizing and retaining presented information, and that these deficiencies could be accounted for by sorting behaviors which suggest inattentiveness to the semantic properties of information at the time the information is presented. There was further suggestion from the subjects' sorting explanations that the impulsive child may lack the ability to inter-relate instances of presented information

through verbal means, and that the young impulsive child, i.e., one who is in his first year of formal schooling, may possess concepts of a more fragmented quality than his reflective peer.

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